E 2218 (Pages : 3) Reg. No.....

Name.....

B.Sc. DEGREE (C.B.C.S.S.) EXAMINATION, OCTOBER 2011

Fifth Semester

Core Course—THERMAL AND STATISTICAL PHYSICS

(Common for (1) Model—I Physics (2) Model—II Physics (3) Physics—EEM and (4) Physics—Instrumentation)

Time : Three Hours Maximum Weight : 25

Part A

Answer **all** *questions.*

Objective type questions—Weight 1 for each bunch.

Bunch I

1. The first law of thermodynamics is concerned with conservation of :
   (a) Energy. (b) Temperature.
   (c) Work. (d) Entropy.
2. The efficiency of an Otto engine is :
   (a) Greater than one. (b) Less than one.
   (c) $\square = 1-\rho$. (d) All the above.
3. The thermodynamic potential at constant temperature and pressure is called :
   (a) Enthalpy. (b) Gibbs free energy.
   (c) Helmholtz free energy. (d) None of these.
4. Searle's method for the determination of conductivity is for :
   (a) Good conductors. (b) Bad conductors.
   (c) Semiconductors. (d) All the above.

Bunch II

5. The area under the indicator diagram is a measure of the :
   (a) Entropy. (b) Work done.
   (c) Internal energy. (d) Reversibility.
6. The absolute zero is a temperature where an engine would work without rejection of any amount of :
   (a) Heat. (b) Gas.
   (c) Diesel. (d) Petrol.
7. In which process work done is maximum :
   (a) Isobaric. (b) Isochoric.
   (c) Isothermal. (d) Adiabatic.
8. According to MB statistics particles are :
   (a) Indistinguishable. (b) Distinguishable.
   (c) Identical. (d) None of these.

Turn over

Bunch III

9. In an isothermal process which of the following is true :
   (a) Temperature remains constant. (b) Pressure remains constant.
   (c) Volume remains constant. (d) Entropy remains constant.
10. During an irreversible process the entropy of the system :
   (a) Decreases. (b) Remains constant.
   (c) Increases. (d) None of these.
11. Of the following which is Stefan's law :
   (a) $R = \sigma T^4$. (b) $R = \sigma T^3$.
   (c) $R = \sigma T^2$. (d) $R = \sigma T$.
12. Maxwell's equation $\left(\frac{\partial T}{\partial P}\right)S$ equals :
   (a) $\left(\frac{\partial V}{\partial S}\right)P$ (b) $\left(\frac{\partial V}{\partial T}\right)V$
   (c) $\left(\frac{\partial T}{\partial V}\right)S$ (d) $\left(\frac{\partial S}{\partial P}\right)T$.

Bunch IV

13. An ideal gas is expanded isothermally such that its volume is doubled. The internal energy of the gas :
   (a) Increases. (b) Doubles.
   (c) Remains the same. (d) All the above.
14. The change in enthalpy during isobaric process is :
   (a) Latent heat. (b) Specific heat.
   (c) Internal energy. (d) All these.
15. Rayleigh-Jeans law holds good for :
   (a) Short wavelength. (b) Longer wavelength.
   (c) High frequency. (d) None of these.
16. Which of the following belongs to thermodynamic potentials ?
   (a) H, U, F, P. (b) H, U, F, G.
   (c) H, U, P, V. (d) H, U, S, P.

$(4 \times 1 = 4)$

Part B

Answer **five** *questions.*

Short answer questions—Weight 1 each.

17. Show that adiabatic is steeper than isothermal.
18. What is an indicator diagram ? State its significance.
19. State and explain Nernst heat theorem.
20. State the principle of entropy.
21. Show that the Helmholtz free energy of a mechanically isolated system never increases during isothermal change.
22. Obtain $\left(\frac{\partial S}{\partial V}\right)_T = \left(\frac{\partial P}{\partial T}\right)_V$.
23. State and explain Rayleigh-Jeans law.
24. What is Gibbs paradox ? Explain briefly. (5 × 1 = 5)

Part C

Answer **four** *questions.*

Short essay/problems. Weight 2 each.

25. A gas at 27°c and 3 atmospheric pressure is suddenly compressed to one fourth of its original volume. Calculate the resulting temperature. $\gamma = 1.4$.
26. Calculate the efficiency of a Carnot engine working between 100°c and ice point.
27. The heat absorbed by a Carnot engine from the source in each cycle is 500 J and the efficiency of the engine is 20%. Calculate the work done in each cycle.
28. Calculate the change in entropy when 30 gram of water at 100°c is converted into steam at 100°c. Latent heat of steam $L = 2.26 \times 10^6$ Jkg^{-1}.
29. Deduce the second TdS equation using Maxwell's relation.
30. Obtain the relation between entropy and thermodynamic probability. (4 × 2 = 8)

Part D

Answer **two** *questions.*

Essay–Weight 4 each.

31. Obtain Mayer's relation starting from first law of thermodynamics.
32. Draw the Diesel cycle. Explain the working of Diesel engine. State the merits.
33. Describe Lee's method for thermal conductivity. (2 × 4 = 8)